SiC-Based Topologies for Grid-Tied Energy Storage Applications (GER-ES)

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1. Introduction:

The electrical distribution network is facing new challenges outside of its original design:

- Accommodating distributed generation and storage.
- Orchestrating power variability, while isolating outages.
- Maintaining safety and reliability.
- Offering notable efficiency gains.

GridBridge's next generation Grid Energy Router for Energy Storage (GER-ES) will facilitate power from distributed resources, offer customers long-term flexibility, improve power quality, and maximize asset utilization. The GER-ES addresses the needs of utilities at the edge of the grid and builds upon current success:

- Compact, versatile, software reprogrammable power and energy management system.
- Internal DC bus serving as the interface to external distributed generation systems and storage.
- Ability to improve reliability and safety, while addressing the increased penetration of distributed devices.
- Demonstrations of GridBridge's base GER technology are ongoing at major utilities.

GridBridge current-state GER installation at major IOU.

Notable improved power density with proposed solution.

2. Approach:

GridBridge is partnering with Cree to further its existing GER platform into a 3ϕ, 12.47 kV solution, which includes an evolution of its DC internal bus to enable energy storage, providing 1ϕ, 120/240VAC output and ultimately a 2x improvement in power density over Si-based systems. **This project is intended to push the envelope of SiC technology.**

This Phase I project leverages:

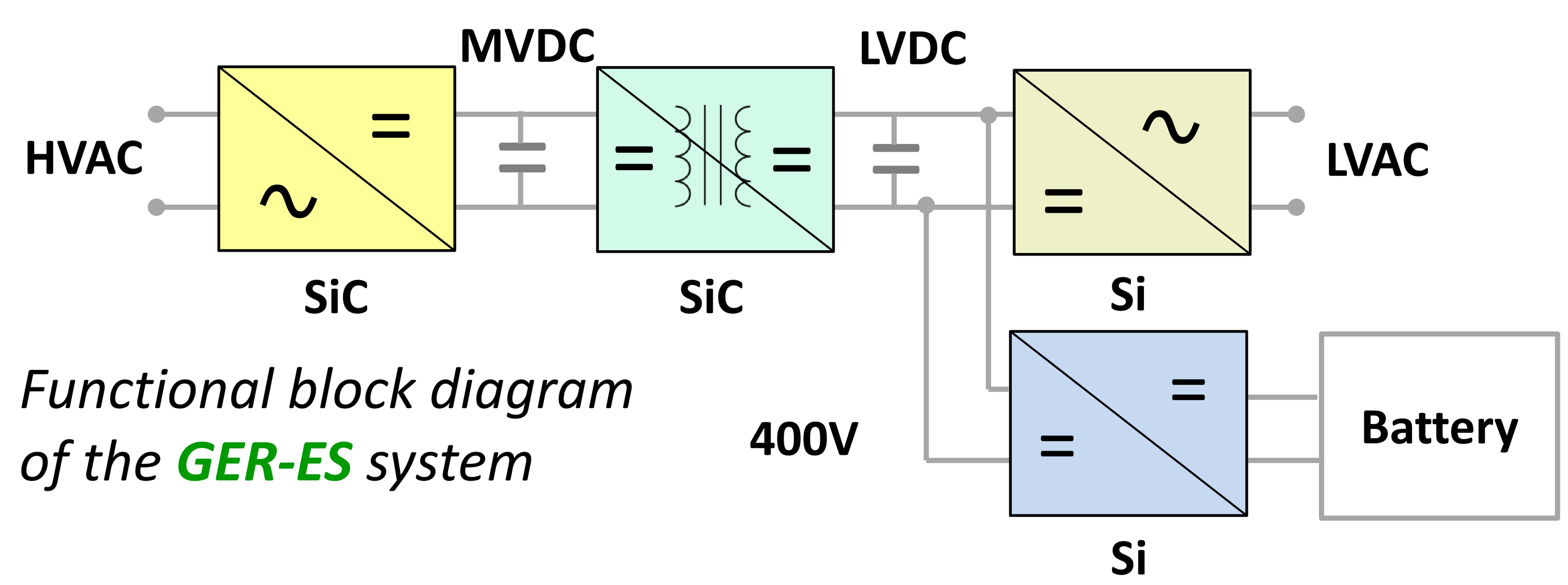
- GridBridge's leadership in 1ϕ, 7.2 kV, Si-based systems and its field-deployed GER platform.
- Cree's high voltage SiC MOSFET expertise.

This Phase I effort is focused on:

- Locate and develop candidate bi-directional topologies, noting the baseline of existing capabilities.
- Deep dive simulation of each topology, noting tradeoffs.
- Further detailed power density and thermal performance analysis with the ideal topology.

The functional diagram of the anticipated overall system is shown below and contains:

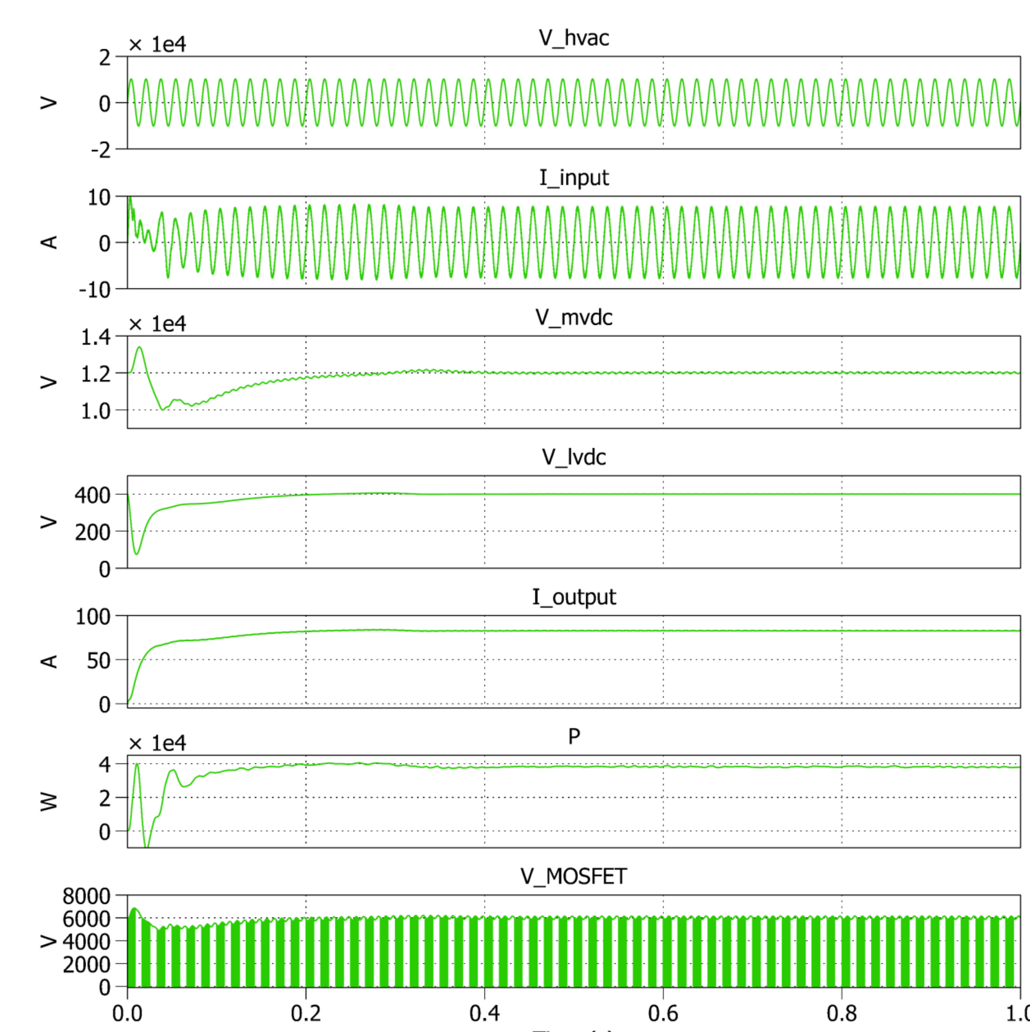
- Both the 7.2kVAC rectifier and MVDC-LVDC converter stages fabricated with SiC MOSFETS.
- LVDC-120/240VAC inverter and LVDC-LVDC converter for batteries potentially employing Si devices.
- 100 kWh of energy storage connecting to the LVDC bus.

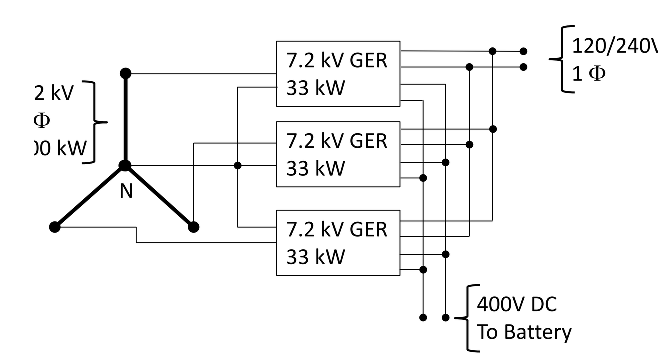


Functional block diagram of the GER-ES system

3. Results:

Candidate topologies identified and developed. An example of one is shown below, which consists of three individual single phase 7.2kV GER's rated at 33 kW, each with their respective outputs connected in parallel to achieve 100 kW operation.





Simulation Parameters	
HVAC	7.2 kV
MVDC	12 kV
LVDC	400 V
Power Rating	33 kW
fswitch	5 kHz (AC/DC) 10.8 kHz (DC/DC)

Simulation results for a one 7.2kV input phase.

4. Acknowledgements:

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